**REMARKS**

Claims 63-84 were pending in this application. Claims 1-62 have been previously canceled. Claims 66, 72, and 74-84 have been amended. Claims 85-88 have been added. Therefore, Claims 63-88 are pending in this application. Reconsideration of the application based on the remaining claims as amended and arguments submitted below is respectfully requested.

Claim Rejections - 35 U.S.C. § 112

Claims 66, 72, 77 and 83 have been rejected under 35 U.S.C. 112 as being indefinite for failing to point out and distinctly claim the subject matter which applicant regards as the invention. Namely, the terms "an optional" has been questioned. Applicant has removed these terms.

Claim Objections

Claims 74-83 and 84 have been objected to because of informalities. Namely the use of the word "providing" for a system claim was objected to. Applicant has amended these claims as required.

Claim Rejections under 35 U.S.C. § 103

Claims 63, 64, 68-70, 74, 75 and 79-81 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Wiggs et al (5,671,608) in view of various

combinations of Aoyagi (6,390,183), Brasz et al (6,892,522), and Schooley et al. (6,521,459).

## Aoyagi Teaches Away from and is Inoperable with a Geothermal DX system

Generally, the Office Action objects to the current claims as being unpatentable over Wiggs '608 in view of Aoyagi '183 stating Wiggs '608 teaches a direct expansion geothermal heat pump and Aoyagi teaches the use of R-410A refrigerant in a refrigerant heat exchanging cycle for the purpose of enhancing heat transfer coefficient and to protect the environment.

According to the Aoyagi disclosure, R-410A and R-290 (propane) are use in Aoyagi's refrigerant heat exchanging system because these refrigerants allegedly have higher densities at the same cycle point as R-22, thereby allegedly lowering pressure loss to about 70% of R-22 in Aoyagi's air-source heat pump system's primary heat exchanger design. Aoyagi's primary heat exchanger design, of course, is comprised of a closed-ended tube, or the like, placed within the primary evaporating and condensing tubes transporting a refrigerant at phase-change conditions. Aoyagi is an air source heat pump design (as is well understood by those skilled in the art), with a heat exchanger comprised of a closed tube, or the like, within an open refrigerant transport tube. To the contrary, Wiggs '608 disclsoes a DX heat pump with open refrigerant transport tubes, with absolutely no

closed end tubes within. Placing closed end tubes within the a geothermal design as taught by Wiggs '608 with specified sizes of refrigerant transport tubing would actually have negative operational effects, likely rendering the previous design inoperable.

In the current application, operational pressure loss is not discussed as a reason for utilizing R-410A in a DX system. As with any refrigerant based cooling system, there will almost always be some pressure loss after the hot gas refrigerant is condensed into a cooler liquid. However, in a DX system application, where cooler condensing temperatures are normally afforded in the summer (via the sub-surface geology's constant cool temperature) than are available to an air-source system (with continuously changing and hot atmospheric temperatures), some pressure loss can be a positive advantage because it provides greater temperature differentials and lower compressor power draw requirements that are not necessarily available to air-source designs, such as Aoyagi's. The reason for utilizing R-410A in a DX system design is to offset the effect of gravity, so as to facilitate condensed refrigerant return in the cooling mode, as opposed to minimizing pressure loss as in Aoyagi's design.

The fact that R-410A poses no threat to the earth's upper ozone layer and is environmentally friendly is nice, and is a fact attributable to the inventor of the refrigerant, but is not the primary reason for its use in a DX system design. The current application is the first to disclose the utilization of a refrigerant, such as R-

410A, that operates between 80 psi and 405 psi ranges, so as to effectively operate a DX system in the cooling mode and to offset the negative effects of gravity when the ground is the condenser.

The simple facts that R-410A is environmentally friendly, allegedly reduces/minimizes operational pressure losses in air-source heat pumps with a closed tube within other heat transfer tubing, allegedly enhances heat transfer coefficients in air-source heat pumps with a closed tube within other heat transfer tubing, and has higher densities at the same cycle point as R-22, would in no way be an obvious indication of the necessity to utilize R-410A in a deep well DX system design.

In fact, a refrigerant that has higher densities than R-22 at the same cycle point would be an obvious disadvantage in offsetting DX system adverse gravitational effects in the cooling mode, in and of itself, since lighter refrigerants would obviously be adversely impacted less by gravity than heavier refrigerants. In a DX system, getting the liquid refrigerant back up out of the ground is the primary concern, not a pressure drop.

Further, Aoyagi teaches his design: (a) increases the refrigerant flow rate in the evaporator, utilizing an R-410A or propane refrigerant, and (b); that his design, utilizing R-410A or propane refrigerant, restrains the average condenser temperature from being lowered in the condenser. For the cited DX systems in

Wiggs '608, this is the exact opposite of the desired effect, teaches away from Wiggs '608, and would not, therefore, be an obvious choice based upon Aoyagi's disclosures.

As a further explanation to (a) above, in a DX system, the ultimate heat transfer medium is the ground, not the air (as in Aoyagi's design). Therefore, since a given area of ground has limited heat transfer capacities, based upon its steady state temperature and thermal conductive heat transfer rates (in BTUs/Ft.Hr. degrees F), as opposed to outside air blown by a fan with unlimited capacities (dependent only on fan speeds and atmospheric temperature conditions for thermal convective heat transfer rates), in DX system designs, it is important not to speed up refrigerant flow rates in the evaporator since heat transfer is dependent upon a calculated steady (not fast) flow rate through a pre-determined amount of refrigerant transfer tubing surface area exposure to the surrounding geology. If one were to speed up the refrigerant flow rate in the evaporator (as taught by Aoyagi for an air-source system) in a DX system design, one would have to place more refrigerant tubing in the ground, which would increase tubing, excavation, and grouting costs (a negative factor), and which would exacerbate liquid refrigerant return concerns in the cooling mode.

As a further explanation to (b) above, in any DX system, condenser temperatures lower than that of typical air-source system designs, such as Aoyagi's, are an advantage, since lower condenser temperatures permit cooler refrigerant to be provided to the interior evaporator (air-handler) and enable more humidity

removal (being further below the dew-point). To the contrary, in an air-source system such as Aoyagi's, higher condensing temperatures are advantageous when outdoor ambient air temperatures are high. However, only several feet below the ground surface in most any geographical location, temperatures do not fluctuate nearly as much as in the air above. In fact, beyond 20 meters deep in the ground, where a deep well DX system is designed to operate, the natural geothermal temperatures are totally unaffected by seasonal increases in ambient air temperatures.

Thus, again, the disclosed purposes of Aoyagi's air-source heat pump system designs, in utilizing R-410A or propane, are the exact opposite for DX system designs, and would, therefore, neither be applicable nor obvious to combine with Wiggs '608

<u>**Brasz Does Not Teach R-410A refrigerant and is operable a DX system**</u>

Regarding the rejections of the current claims over Wiggs '608 in view of Brasz (6,892,522), Brasz's invention would not have been considered by one skilled in the art for combination with a deep well DX reverse-cycle geothermal heating/cooling system. Brasz was teaching the use of a cooling mode refrigerant system to cool the air entering a turbine engine, which cooling mode refrigerant system was taught as preferably having reduced operational pressures between 50 and 180 psi. This does not teach having increased operational pressures up to 405

psi, as taught by Wiggs '608 (in order to offset the effects of gravity in the cooling mode). For the example, as is well understood by those skilled in the art, the lower psi ranges cited are on the suction side of the compressor and the higher psi ranges cited are on the hot gas discharge side of the compressor.

Brasz's design taught the use of a refrigerant that had significantly lower operational pressures than R-410A, with Brasz not even citing an R-410A refrigerant. Brasz states:

> "If the same apparatus is used for an organic rankine cycle turbine application as for a centrifugal compressor application, the applicants have recognized that a different refrigerant must be used. That is, if the known centrifugal compressor refrigerant R-134a is used in an organic rankine cycle turbine application, the pressure would become excessive. That is, in a centrifugal compressor using R-134a as a refrigerant, the pressure range will be between 50 and 180 psi, and if the same refrigerant is used in a turbine application as proposed in this invention, the pressure would rise to around 500 psi, which is above the maximum design pressure of the compressor. For this reason, it has been necessary for the applicants to find another refrigerant that can be used for purposes of turbine application. Applicants have therefore found that a refrigerant R-245fa, when applied to a turbine application, will operate in pressure ranges

> between 40-180 psi as shown in the graph of FIG. 8. This range is acceptable for use in hardware designed for centrifugal compressor applications."

This clearly evidences that Brasz's design taught the use of a refrigerant (other than R-410A, with Brasz not even citing an R-410A refrigerant) that had significantly lower operational pressures than R-410A, for use in a completely different application than a DX System. Further, the use of an R-143a refrigerant, as taught by Brasz, would be one of extremely inefficient and totally operable in the Wiggs '608 DX system.

<u>Schooley Does Not Teach a Polyolester Lubricant for a DX system</u>

Regarding the examiner's objections to Wiggs' inventions over Schooley (6,521,459), Schooley does not teach that a polyolester lubricant should preferably be utilized in a deep well DX system design with a high pressure R-410A refrigerant. Schooley makes no reference to R-410A, and makes no reference to what lubricant should preferably be used in a high pressure R-410A DX refrigerant system. The only reference made to polyolester by Schooley is as follows in the Detailed Description:

> The acid test kit is used to determine the fitness of a lubricant, such as a polyolester lubricant, a polyvinyl ether, mineral oil, or alkyl benzene, used in a climate control system. The acid test kit can be used

> to rapidly determine excess acid content in lubricants due to a partial breakdown of the lubricant into organic acids. An acid content above a threshold value indicates that the lubricant has broken down to such an extent as to render it unfit for further use within the compressor.

Schooley's invention was for an acid test kit. The kit could be used to test the fitness (based upon the breakdown of the lubricant into organic acids) of any one of four named lubricants, that might potentially be used in any climate control system.

Schooley did not disclose which lubricant to use with which refrigerant, much less which lubricant to use with R-410A in a DX system application. Schooley's simple reference that a polyolester lubricant is one of four named lubricants for potential use in any climate control system (again, not even mentioning a reverse-cycle heat pump system, much less a highly specialized deep well DX system), could not possibly be used to ascertain the preferred lubricant for use with an R-410A refrigerant in a deep well DX, reverse-cycle, DX system application as taught by the present invention. The mere mention, or even existence, of potential possibilities of lubricants for any climate control system does not factually teach what refrigerant lubricant would actually be preferred for use in a DX system design with an R-410A refrigerant.

## Allowable Subject Matter

The Examiner specifically stated that Claims 65, 67, 71, and 73 were objected to but would be allowable if rewritten to include all of the features of the base claim and any intervening claims. Applicant has added Claims 85-88 including the features as suggested by the Examiner.

Additionally, the only rejection or objection to Claims 76, 78, 82, and 84 was the objected to informalities in the Claims. As such, Applicant offers Claims 76, 78, 82, and 84-88 should be allowable.

Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and Applicant hereby reserves the right to present additional distinctions as appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Supplemental Response to Deposit Account 23-0035.

Respectfully submitted,

/Phillip E. Walker, 52,336/
Phillip E. Walker
Registration No. 52,336
WADDEY & PATTERSON
A Professional Corporation
Customer No. 23456

ATTORNEY FOR APPLICANT

Phillip E. Walker
Waddey & Patterson
1600 Division Street, Suite 500
Roundabout Plaza
Nashville, TN 37203
(615) 242-2400